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SENSORY INFORMATION FROM AFFERENT NEURONS

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PROGRESS REPORT #6

for the period

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prepared by

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NEURAL PROSTHESIS

Summary of Progress in the Sixth Period

During the sixth reporting period we implanted four more animals (for a total of five) with either Multi-Contact Cuffs (MCCs--3 animals) or Longitudinal Intra-Fascicular Electrodes (LIFEs--2 animals) located in the Median, Ulnar and Radial nerves above the elbow. The LIFE implants also received EMG-suppression barriers in the form of sheets of silicone film that were sutured to the inside surface of the biceps and triceps muscles around the LIFE electrode implant locations. We also implanted an individual tripolar single-channel cuff in each of the Median, Ulnar and Radial nerves below the elbow, and a bipolar EMG electrode in each of six muscles of the forelimb.

Following implantation, we proceeded to monitor on a regular basis compound action potentials, device impedances and trends in multichannel recording selectivity using electrical stimulation of the distal cuffs and EMG electrodes under gas anesthesia. We also recorded multi-channel nerve and muscle activity during treadmill walking and during reaching and grasping of a computer-controlled joystick with the left forelimb.

Results with this group of animals have been generally disappointing due to premature failures in both types of multichannel devices.

Initially the LIFEs provided high selectivity to electrical stimulation under anesthesia. However, in the awake recordings the neural signals were swamped with EMG pickup, in spite of the protective barriers and high-pass filtering at 1 kHz. In one animal, impedances changed and most of the LIFEs failed to record neural signals within 1 month of implant, indicating that the wires had broken, whereas in the second animal most of the LIFEs were still functional after three months, but gave very small neural signals and large EMG contamination.

The multi-contact cuffs implanted in this group of animals were of a new design that utilized a different formulation of silicone from what we had used in all previous implants. In two of the MCC-implanted animals, since early in the recording period most of the MCC electrodes were contaminated with excessive EMG and also exhibited large motion artifacts. In the third animal, most of the electrodes provided reasonable neural signals during the first three months, but some of the electrodes eventually also showed similar contamination. This finding was attributed to insufficient insulation provided by the silicone formulation used. The distal cuffs, made of standard silicone, performed very well in all 5 animals.

Plans for the Seventh Period

During the seventh reporting period, from April 1, 1998 to June 30, 1998, we will complete the recordings from this set of animals. We will also produce multi-channel cuffs using our standard silicone formulation for implantation in the next set of animals, and explore options for providing better EMG rejection for LIFEs.